

Geotechnical Engineering Examination Test Plan

Adopted December 2001

Definition of Geotechnical Engineering

Geotechnical Engineering is defined as the investigation and engineering evaluation of earth materials including soil, rock, groundwater and man-made materials and their interaction with earth retention systems, structural foundations and other civil engineering works. The practice involves application of the principles of soil mechanics and the earth sciences, and requires knowledge of engineering principles, formulas, construction techniques and performance evaluation of civil engineering works influenced by earth materials. (Title 16, CCR section 404).

The area of practice is structured into six primary content areas. The percentage given in parentheses represents the proportion of total test points that will address that test plan area.

- I. Reconnaissance and Project Planning (11%)
- II. Field Exploration (6%)
- III. Laboratory Testing (12%)
- IV. Analyses and Development of Conclusions and Recommendations (49%)
- V. Report Preparation (13%)
- VI. Document Review, Construction Monitoring, and Post Construction Observations (9%)

Glossary of Terms Used in Task Statements

The following abilities are arranged hierarchically from the most complex to the least complex. That is, **describe** constitutes the least complex ability in the hierarchy and **develop** constitutes the most complex. Each ability presupposes all abilities preceding it in the hierarchy. For example, the ability to **evaluate** presupposes the abilities to **determine** and **describe**.

As used in the test plan, the following abilities are defined as:

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| Develop | To formulate and define geotechnical scope, conclusions, recommendations and requirements. |
| Analyze | A detailed study of findings using geotechnical engineering principles. |
| Evaluate | Using engineering judgment, apply appropriate criteria to interpret data. |
| Determine | To measure, monitor, define, discover, identify or establish geotechnical engineering parameters relative to a project. |
| Describe | To communicate a detailed account of findings, conclusions or recommendations. |

**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

I. Reconnaissance and Project Planning – 11%

Evaluate available site and project information. Develop scope of geotechnical work, work plan, and project proposal.

| Job Tasks | | Associated Knowledges | |
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| <i>T1</i> | Determine project description based on client's requirements and other relevant information. | <i>K1</i> | K of methodologies to develop a scope of work for geotechnical investigation. |
| <i>T2</i> | Evaluate relevant data about site and subsurface conditions by reviewing available regional and site-specific information. | <i>K2</i> | K of methodologies to gather available information relevant to site and project. |
| <i>T3</i> | Evaluate potential geotechnical issues that may influence design and construction of the proposed project. | <i>K3</i> | K of techniques to review and interpret existing data for the site. |
| <i>T4</i> | Develop proposal or work plan for field exploration, laboratory testing, analyses, and/or recommendations for the proposed project. | <i>K4</i> | K of engineering principles that affect geotechnical planning. |
| | | <i>K5</i> | K of effects of geology and geomorphology on geotechnical planning. |
| | | <i>K6</i> | K of effects of local and regional geologic hazards on project planning. |
| | | <i>K7</i> | K of environmental issues that affect geotechnical and/or project planning. |
| | | <i>K8</i> | K of exploration methodologies that affect project work plan. |
| | | <i>K9</i> | K of regulatory requirements and codes that affect project work plan. |
| | | <i>K10</i> | K of risk and liability issues associated with developing project plans. |
| | | <i>K11</i> | K of field instrumentation methodologies that affect project work plan. |
| | | <i>K12</i> | K of the current "standard of care" for geotechnical investigations. |
| | | <i>K13</i> | K of different laboratory tests including their application to site characterization and analyses. |
| | | <i>K14</i> | K of geotechnical requirements for different types of construction. |

K=Knowledge

**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

II. Field Exploration – 6%

Determine and document surface and subsurface conditions, samplings, field tests, and instrumentation. Evaluate adequacy of field exploration and modify programs as required.

| Job Tasks | | Associated Knowledges | |
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| <i>T5</i> | Determine surface conditions by performing detailed reconnaissance. | <i>K15</i> | K of how to locate proposed exploration points in the field |
| <i>T6</i> | Evaluate subsurface and groundwater conditions by performing subsurface exploration, sampling and preparing field logs of explorations. | <i>K16</i> | K of safety regulations pertaining to site exploration. |
| <i>T8</i> | Evaluate the need for changes to proposed exploration program during field investigations. | <i>K17</i> | K of field exploration methods to evaluate subsurface conditions. |
| | | <i>K18</i> | K of different types of field instrumentation and their purposes. |
| | | <i>K19</i> | K of different types of field sampling techniques and their purposes. |
| | | <i>K20</i> | K of in situ testing methods and factors that influence the validity of the results. |
| | | <i>K21</i> | K of conditions that affect geotechnical field sampling techniques. |
| | | <i>K22</i> | K of procedures to follow when suspected hazardous materials are encountered in field investigations. |
| | | <i>K23</i> | K of environmental factors that affect geotechnical exploration. |
| | | <i>K24</i> | K of methods to document site conditions. |
| | | <i>K25</i> | K of field procedures to log subsurface conditions. |
| | | <i>K26</i> | K of factors that may alter the work plan during field investigation. |
| | | <i>K27</i> | K of regulatory requirements and codes that affect field investigations. |

K=Knowledge

**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

III. Laboratory Testing – 12%

| Determine appropriate laboratory tests and evaluate results to establish engineering and physical properties of earth materials. | | | |
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| Job Tasks | | Associated Knowledges | |
| <i>T9</i> | Evaluate shear strength parameters from results of laboratory testing. | <i>K28</i> | K of effects of drilling and sampling methods on laboratory test results. |
| <i>T10</i> | Evaluate moisture-density relationship of soil from results of laboratory testing. | <i>K29</i> | K of procedures and interpretation of direct shear tests. |
| <i>T12</i> | Evaluate soil deformation parameters from results of laboratory compression and swell tests. | <i>K30</i> | K of procedures and interpretation of triaxial tests. |
| <i>T13</i> | Evaluate index properties of soil from results of laboratory testing. | <i>K31</i> | K of procedures and interpretation of unconfined compression tests. |
| <i>T15</i> | Evaluate pavement subgrade soil characteristics from results of laboratory testing. | <i>K32</i> | K of procedures and interpretation of moisture content tests. |
| <i>T17</i> | Evaluate the need for changes to laboratory testing program. | <i>K33</i> | K of procedures and interpretation of dry density tests. |
| | | <i>K34</i> | K of procedures and interpretation of permeability tests. |
| | | <i>K35</i> | K of procedures and interpretation of compaction tests. |
| | | <i>K36</i> | K of procedures and interpretation of collapse tests. |
| | | <i>K37</i> | K of procedures and interpretation of expansion swell/expansion tests. |
| | | <i>K38</i> | K of procedures and interpretation of consolidation tests. |
| | | <i>K39</i> | K of procedures and interpretation of Atterberg Limits tests. |
| | | <i>K40</i> | K of procedures and interpretation of grain size distribution tests. |
| | | <i>K42</i> | K of procedures and interpretation of R-value tests. |
| | | <i>K45</i> | K of procedures and interpretation of corrosivity/chemical tests. |
| | | <i>K47</i> | K of procedures and interpretation of specific gravity tests. |
| | | <i>K49</i> | K of procedures and interpretation of Sand Equivalent tests. |

K=Knowledge

**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

IV. Analyses and Development of Conclusions and Recommendations - 49%

| Perform analyses using project requirements, and field and laboratory data. Develop conclusions and recommendations regarding design and construction of project. | |
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| Job Tasks | Associated Knowledges |
| <i>T18</i> Develop a model to characterize the engineering properties of the subsurface strata by integration of field and laboratory data for use in analyses. | <i>K50</i> K of evaluating feasibility of alternate solutions. <i>K51</i> K of immediate settlement analyses and the impact on proposed site uses. |
| <i>T19</i> Analyze settlement to develop conclusions and recommendations based on project requirements and field and laboratory data. | <i>K52</i> K of consolidation analyses and the impact on proposed site uses. <i>K53</i> K of seismically induced settlement analyses and the impact on proposed site uses. |
| <i>T20</i> Analyze collapse potential to develop conclusions and recommendations based on project requirements, and field and laboratory data. | <i>K54</i> K of evaluating impacts of construction procedures to develop conclusions and recommendations. <i>K55</i> K of procedures to determine site acceleration. |
| <i>T21</i> Analyze seismic induced settlement to develop conclusions and recommendations based on project requirements, and field and laboratory data. | <i>K56</i> K of procedures to develop shoring recommendations. <i>K57</i> K of procedures to develop temporary excavation recommendations. |
| <i>T22</i> Develop recommendations for code related seismic design criteria based on project requirements, analyses performed and field and laboratory data. | <i>K58</i> K of techniques for ground improvement or modification. <i>K59</i> K of impact of geotechnical recommendations on proposed construction. |
| <i>T23</i> Analyze site acceleration to develop conclusions and recommendations based on project requirements, and field and laboratory data. | <i>K60</i> K of soil expansion analyses and the impact on proposed site uses. <i>K61</i> K of seismic slope stability including deformation analyses and the impact on proposed site uses. |
| <i>T24</i> Develop recommendations concerning geologic hazards based on project requirements, analyses performed, and field and laboratory data. | <i>K62</i> K of static slope stability analyses and the impact on proposed site uses. <i>K63</i> K of analyses of lateral capacity of deep foundations and the impact on proposed site uses. |
| <i>T25</i> Analyze liquefaction potential to develop conclusions and recommendations based on project requirements, and field and laboratory data | <i>K64</i> K of analyses of axial capacity of deep foundations and the impact on proposed site uses. |

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

IV. Analyses and Development of Conclusions and Recommendations Cont. - 49%

| Perform analyses using project requirements, and field and laboratory data. Develop conclusions and recommendations regarding design and construction of project. | |
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| Job Tasks | Associated Knowledges |
| <i>T26</i> Analyze lateral spreading to develop conclusions and recommendations based on project requirements, and field and laboratory data. | <i>K65</i> K of analyses of bearing capacity of shallow foundations and the impact on proposed site uses. |
| <i>T27</i> Analyze slope stability to develop conclusions and recommendations based on project requirements, and field and laboratory data. | <i>K66</i> K of engineering applications for geosynthetics |
| <i>T28</i> Analyze vertical and lateral load capacity to develop conclusions and recommendations for shallow foundation based on project requirements, and field and laboratory data. | <i>K67</i> K of effects of regulatory requirements, including health and safety regulations, on formulation of recommendations and specifications. |
| <i>T29</i> Analyze vertical and lateral load capacity to develop conclusions and recommendations for deep foundation based on project requirements, and field and laboratory data. | <i>K68</i> K of analyses of erosion potential and the impact on proposed site uses. |
| <i>T30</i> Analyze lateral earth pressures to develop conclusions and recommendations for earth retention systems based on project requirements, and field and laboratory data. | <i>K69</i> K of analyses of soil collapse potential and the impact on proposed site uses. |
| <i>T31</i> Analyze soil expansion and/or swell potential to develop conclusions and recommendations based on project requirements, and field and laboratory data. | <i>K70</i> K of liquefaction analyses and the impact on proposed site uses. |
| <i>T32</i> Develop recommendations for slab-on-grade support based on project requirements, analyses performed and field and laboratory data. | <i>K71</i> K of seepage analyses and the impact on proposed site uses. |
| <i>T33</i> Analyze subgrade properties to develop conclusions and recommendations for pavement sections based on project requirements, and field and laboratory data. | <i>K72</i> K of procedures to develop subdrain design based on field and laboratory data. |
| <i>T34</i> Develop recommendations for site earthwork based on project requirements, analyses performed, and field and laboratory data. | <i>K73</i> K of dewatering analyses and the impact on proposed site uses. |
| | <i>K74</i> K of lateral spreading analyses and the impact on proposed site uses. |
| | <i>K75</i> K of static lateral earth pressures analyses and the impact on proposed site uses. |
| | <i>K76</i> K of seismic lateral earth pressures analyses for earth retention systems and the impact on proposed site uses. |
| | <i>K77</i> K of seismic criteria and applicable codes. |
| | <i>K78</i> K of methods to evaluate impact of geologic hazards on proposed site uses. |
| | <i>K79</i> K of procedures to determine risk and safety factors for incorporation into design recommendations. |

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**GEOTECHNICAL ENGINEERS
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IV. Analyses and Development of Conclusions and Recommendations Cont. - 49%

| Perform analyses using project requirements, and field and laboratory data. Develop conclusions and recommendations regarding design and construction of project. | |
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| Job Tasks | Associated Knowledges |
| <i>T36</i> Analyze seepage and groundwater conditions to develop conclusions and recommendations based on project requirements, and field and laboratory data. | <i>K80</i> K of evaluating impacts of site recommendations on adjacent properties. |
| <i>T37</i> Develop recommendations regarding ground improvement or ground modifications based on project requirements, analyses performed, and field and laboratory data. | <i>K81</i> K of analyses of post- tensioned slab design and the impact on proposed site uses. |
| <i>T38</i> Analyze data from results of field instrumentation program to develop conclusions and recommendations based on project requirements and field data. | <i>K82</i> K of analyses to evaluate suitability of fill materials and the impact on proposed site uses. |
| <i>T39</i> Develop recommendations regarding geotechnical applications of geosynthetics | <i>K83</i> K of techniques to characterize the engineering properties of the subsurface strata by integration of field and laboratory data. reasonable. |
| <i>T40</i> Develop a quality assurance program for project construction to determine conformance with recommendation in geotechnical report. | <i>K84</i> K of procedures to determine if field and laboratory data are |
| <i>T42</i> Develop remedial recommendations based on analyses of post construction distress. | <i>K85</i> K of methods to evaluate post-construction distress. |
| | <i>K86</i> K of pavement analyses and the impact on proposed site uses |

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

V. Report Preparation – 13%

| Describe scope, purpose, methods, findings, conclusions, recommendations, and limitations of geotechnical investigation. | |
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| Job Tasks | Associated Knowledges |
| <i>T43</i> Describe project scope and purpose of work in a formal written report. | <i>K87</i> K of major components of geotechnical investigation reports. |
| <i>T44</i> Describe findings of document review, reconnaissance, field exploration, laboratory testing, and analyses in a formal written report. | <i>K88</i> K of current applicable references. |
| <i>T45</i> Describe methodologies used in field exploration, lab testing and analyses in a formal written report. | <i>K89</i> K of major components of guideline specifications for geotechnical aspects of proposed project. |
| <i>T46</i> Describe conclusions and recommendations based on geotechnical findings in a formal written report. | <i>K90</i> K of the limitations of the geotechnical investigation. |
| <i>T47</i> Describe limitations of the findings, conclusions and recommendations of the geotechnical investigation in a formal written report. | <i>K91</i> K of major elements of field and laboratory documentation. |
| <i>T48</i> Describe site plan, logs of field exploration, soil profiles/cross-sections, laboratory test data, references and guideline specifications in a formal written report. | |

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VI. Document Review, Construction Monitoring, and Post-Construction Observations – 9%

| Evaluate conformance of contract plans and specifications with geotechnical recommendations. Observe, monitor, test, evaluate, and document geotechnical aspects of construction. | |
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| Job Tasks | Associated Knowledges |
| <p><i>T49</i> Evaluate site conditions before, during, and/or following construction by installing, monitoring, and evaluating results of geotechnical instrumentation.</p> <p><i>T50</i> Evaluate conformance with geotechnical recommendations by reviewing plans and specifications.</p> <p><i>T51</i> Evaluate conformance with geotechnical aspects of specifications by observing and testing during construction activities.</p> <p><i>T52</i> Describe results of construction monitoring and post-construction observations.</p> | <p><i>K92</i> K of methods to verify that project construction conforms to geotechnical plans and specifications.</p> <p><i>K93</i> K of required components to document construction and post-construction observations and monitoring.</p> <p><i>K94</i> K of effects of regulatory requirements, including health and safety regulations during construction.</p> <p><i>K95</i> K of factors to consider when reviewing plans and specifications for geotechnical issues.</p> <p><i>K96</i> K of methods to interpret observations and instrumentation data during construction.</p> <p><i>K97</i> K of procedures to follow when suspected hazardous materials are encountered during construction.</p> <p><i>K98</i> K of techniques to mitigate unanticipated geotechnical conditions encountered during construction.</p> |

K=Knowledge